Stage: **10.4**
                        Programming Stage

Responsibility: Project Team

Description: In the Programming Stage, the results of the Design Stage, the current source code, the project and system documentation, (i.e., the entire system as updated by the prior stages) is used to drive the programming effort. *Exhibit 10.4-1* (provided at the end of the section) summarizes the input, control, and output for the Programming stage.

Input: Input to the Programming Stage of software maintenance includes the following:

                        •   Results of the Design Stage
                        •   Current source code, comments, and data bases
                        •   Project and system documentation

Process: The Programming Stage includes the following tasks, which may be conducted in an incremental, iterative approach:

                        •   Coding and unit testing
                        •   Integration
                        •   Revisit project risk
                        •   Test readiness review

Coding and
Unit Testing: Implement the change into the code and perform unit testing. Other quality assurance and verification and validation processes may be required for safety-related code. The Quality Assurance Team can help with specific issues.

Integration: After the modifications are coded and unit tested, or at appropriate intervals during coding, the modified software is integrated with the system, and integration and regression tests are refined and performed. All effects (e.g., functional, performance, usability, safety) of the modification on the existing system are assessed and noted. A return to the coding and unit testing tasks is made to remove any unacceptable impacts.

Risk Analysis
and Review: Risk analysis and review are performed periodically during the Programming Stage rather than at the end, as in the Design and Analysis Stages. Metrics/measurement data should be used to quantify risk analysis.

Test Readiness
Review: To assess the team's preparedness to enter system testing, a Test Readiness
                     Review is conducted. This is a self assessment to determine if items including
                     code, documentation, libraries, hardware, telecommunication lines, and
                     schedules are ready for system test to begin on the scheduled date.

Control: Control of the Programming Stage includes the following activities:

                     •   Conduct structured walkthroughs of the code

                     •   Ensure that unit and integration testing are performed and documented
                              in the Project File

                     •   Ensure that test documentation (e.g., test plans, test cases, and test
                              procedures) are either updated or created

                     •   Identify, document, and resolve any risks exposed during software and
                              test readiness reviews

                     •   Verify that the new software is placed under software configuration
                              management control

                     •   Verify that the training and technical documentation have been updated

                     •   Verify the traceability of the design to the code

Work Products: The output of the Programming Stage includes the following:

                     •   Updated software
                     •   Updated design documentation
                     •   Updated test documentation
                     •   Updated user documentation
                     •   Updated training material
                     •   Statement of risk and impact to users
                     •   Test Readiness Review report

Review Process: Conduct structured walkthrough(s), In-Stage Assessment(s), and a Stage Exit.

Exhibit 10.4-1. Programming Stage

```
                    Conduct structured walkthrough
                    Ensure testing performed and documented
                    Verify:
                      New software placed under configuration management
                      Documentation has been updated
                      Traceability of design to code
                                        T
                                        *
Results of Design Stage                 ▾                    Updated:
Source code                       +)))))))))))),              Software
Project documentation      S)))) ▸ *Programming  * S))) ▸   Design documents
System documentation              .)))))))))))))-            Test documents
                                        T                     User documents
                                        *                     Training material
                                        R                     Project Plan
                                                          Test Readiness Rev. rpt.
                           Metrics/measures
                           Structured walkthrough(s)
                           In-Stage Assessment(s)
                           Stage Exit
```